Electrical Circuit Design using Latex

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Contents

***Abstract*—This module explains how to draw electrical circuits using latex.**

1 Installation of Latex Package

Installation of all packages at once

```
sudo apt-get install texlive-full
```

Installation or Loading of individual packages

For installing or updating particular package of texlive, we should go with following commands. In the module we make use of '*circuitikz*' package, so the following helps to install or load '*circuitikz*' into texlive.

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```
sudo apt-get install xzdec
```

xzdec is an texlive package manager dependency. Initialize LaTeX package database

```
tlmgr init-usertree
```

Install the *circuitikz* package

```
tlmgr install circuitikz
```

Thus texlive (Latex) package can be installed or loaded.

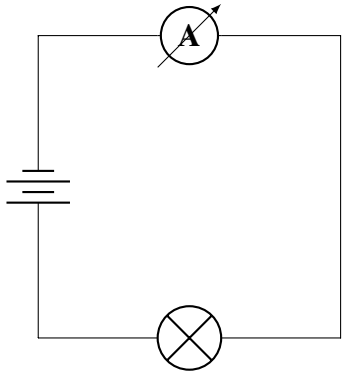
Documentation main frame

```
\documentclass[12pt]{article}

\usepackage{circuitikz}
\begin{document}




\end{document}
```

2 Analog Circuits

2.1 Current Measurement Circuit

```
\begin{center}
\begin{circuitikz} \draw
(0,0) to[battery] (0,4)
      to[ammeter] (4,4) -- (4,0)
      to[lamp] (0,0)
;
\end{circuitikz}
\end{center}
```

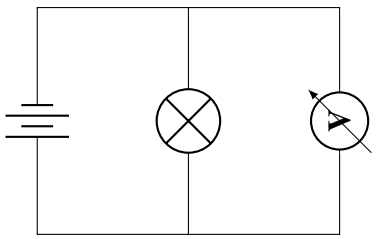


Description ::

- The first line "*(0,0) to[battery] (0,4)*" says that place a battery in between (0,0) & (0,4)
- The second line "*(4,4) to[battery] (4,0)*" says that place an ammeter in between (4,4) & (4,0) and Draw a line form (4,4) to (4,0)
- The third line "*(4,0) to[battery] (0,0)*" says that place lamp in between (4,0) & (0,0)

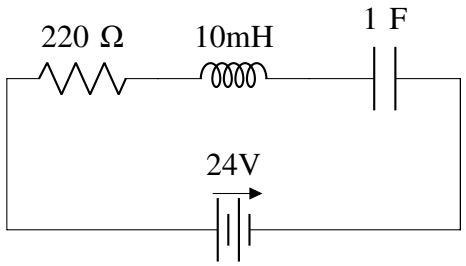
2.2 Voltage Measurement Circuit

```
\begin{center}
\begin{circuitikz}
\draw
(0,0) to[battery] (0,4) -- (2,4)
      to[lamp]    (2,0) -- (4, 0)
      to[voltmeter] (4, 4) -- (2,
         4)
      (2,0) -- (0,0);
\end{circuitikz}
\end{center}
```



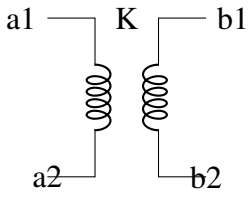
2.3 RLC Circuit

```
\begin{center}
\begin{circuitikz}
\draw
(0,0) to[battery] (6,0) -- (6, 2)
(0,0) -- (0,2) to[R = 220 \ohm]
   (2,2) to[L = 10 mH] (4,2) to[C =
    1 F] (6,2) -- (6,0) ;
\end{circuitikz}
\end{center}
```



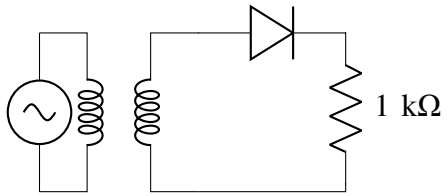
Circuit with bipoles can be drawn using above syntax. But for monopoles and multipoles the following syntax should be used

```
\begin{center}
\begin{circuitikz}
\draw
(0,0) node[transformer] (T) {}
(T.A1) node[anchor = east] {a1}
(T.A2) node(anchor = east) {a2}
(T.B1) node[anchor = west] {b1}
(T.B2) node(anchor = west) {b2}
(T.base) node{K}
;
\end{circuitikz}
\end{center}
```



2.4 Half Wave Rectifier Circuit

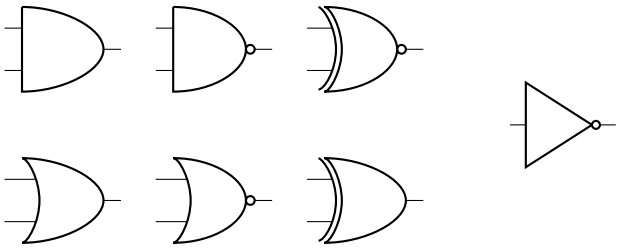
```
\begin{center}
\begin{circuitikz}
\draw
 (0,2) node[transformer] (T1){}
 (T1.A1) to[sinusoidal voltage
    source] (T1.A2)
 (T1.B1) to[diode] (3, 2) to[R]
    (3,0) |- (T1.B2)
;
\end{circuitikz}
\end{center}
```



3 Digital Circuits

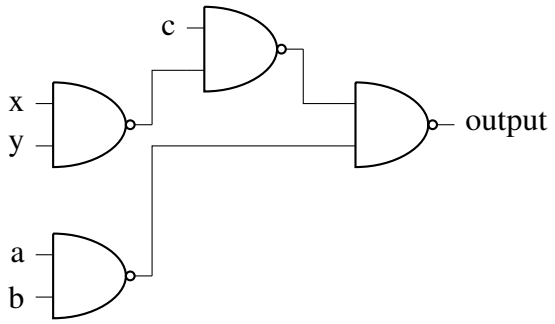
3.1 Basic Gates

```
\begin{center}
\begin{circuitikz}
\draw
(4,0) node[xor port]{}
(4,2) node[xnor port]{}
(2,0) node[nor port]{}
(2,2) node[nand port]{}
(0,0) node[or port]{}
(0,2) node[and port]{}
(6,1) node[not port]{}
;
\end{circuitikz}
\end{center}
```



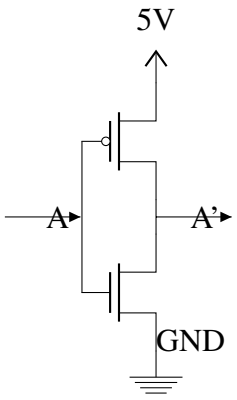
3.2 Logic Circuit

```
\begin{center}
\begin{circuitikz}
\draw
  (0,2) node[nand port] (nand4) {}
  (2,3) node[nand port] (nand3) {}
  (4,2) node[nand port] (nand2) {}
  (0,0) node[nand port] (nand1) {}
  (nand1.out) |- (nand2.in 2)
  (nand4.out) |- (nand3.in 2)
  (nand3.out) |- (nand2.in 1)
   (nand1.in 1) node[anchor = east
      ] {a}
   (nand1.in 2) node[anchor = east
      ] {b}
   (nand3.in 1) node[anchor = east
      ] {c}
   (nand4.in 1) node[anchor = east
      ] {x}
   (nand4.in 2) node[anchor = east
      ] {y}
   (nand2.out) node[anchor = west]
       {output}

  ;
\end{circuitikz}
\end{center}
```



4 FET Transistor Logic

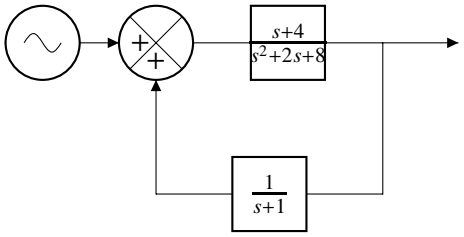
```
\begin{center}
\begin{circuitikz}
\draw
(0,3) node[pmos, emptycircle] (P1)
   {}
(0,1) node[nmos](N1) {}
(P1.drain) -- (N1.drain)
(P1.source) node[vcc] {5V}
(N1.source)  node[ground](G) {GND}
(P1.gate) |- (N1.gate)
(-2,2) -- (-1,2) node[inputarrow]
   (inr1){}
(inr1.1) node[anchor = east] {A}
(0,2) -- (1,2) node[inputarrow] (
   inr2){}
(inr2.1) node[anchor = east] {A'}
;
\end{circuitikz}
\end{center}
```



5 Signal Flow Graph

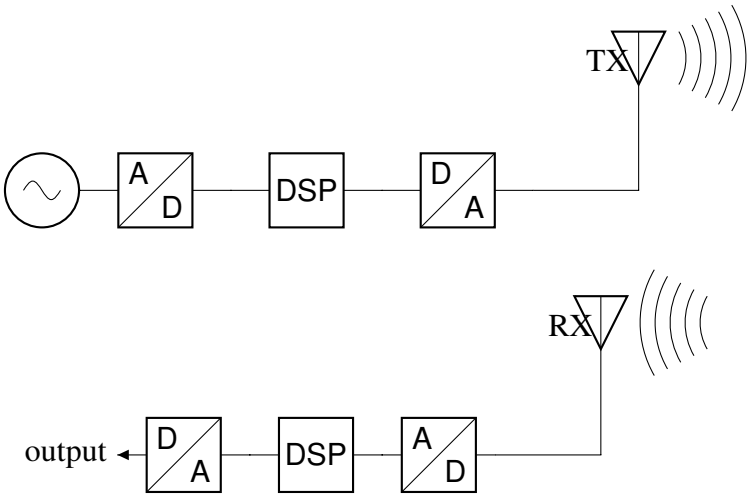
```
\begin{center}
\begin{circuitikz}
\draw
(0,0) to[vco] (1,0) to[adc] (3,0)
   to[dsp] (5,0) to[dac] (7,0) node
   [txantenna] {TX}
(1.5,-3.5) to[dac] (3.25,-3.5) to[
   dsp] (5,-3.5) to[adc] (6.5,-3.5)
    node[rxantenna] {RX}
(1.5, -3.5) node[inputarrow,
   rotate = 180] (inr) {}
(inr.1) node[anchor = east] {
   output}
;
\end{circuitikz}
\end{center}
```

```
\draw
(0,0) to[vco] (1,0)
(2,0) node[mixer] (M) {}
(M.1) -- (1,0)
(M.3) to[twoport, t= $\frac{s +4}{
   s^2 + 2s +8}$] (5,0) --(6,0)
   node[inputarrow] {}
(5,0) -- (5,-2) to[twoport, t = $\
   frac{1}{s+1}$] (2,-2) -- (M.2)
(M.1) node[inputarrow] {}
(M.2) node[inputarrow, rotate =90]
    {}
(M.1) node[anchor = west] {+}
(M.2) node[anchor = south] {+}
;
\end{circuitikz}
\end{center}
```



References

[1] Electric Circuit Design https://github.com/PrasannaIITH/circuitikz



6 Control System

```
\begin{center}
\begin{circuitikz}
```